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BUILDING ENERGY PERFORMANCE CERTIFICATE, ENERGY MANAGEMENT ACT AND EXISTING BUILDINGS – ASSESSMENT AND ACTUAL SITUATION IN THE CZECH REPUBLIC

Abstract

In the European Union is nowadays necessary to build energy-efficient buildings. This premise is set out in Directive 2010/31/EU. The EU Member States are obligated to implement the requirements of this Directive into their national legislation. In the Czech Republic is this implementation provided by Act. No. 406/200 Coll. Energy management. In accordance with this act there is necessity to form Building Energy Performance Certificate not only for new buildings, but for some of existing buildings as well, and even in case of sale or lease. Assessment process for the existing buildings is not simple. It is essential to know all constructions and their real compositions and dimensions. This article shows appropriate evaluation process of the existing buildings on a flowchart. These steps lead to procuring of the precise certificate.

Introduction

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings [1] set out the main conditions to ensure energy-efficient buildings. The EU Member States are obligated to implement the requirements of this Directive into their national legislation.

In the Czech Republic is obligatory Act No. 406/2000 Coll. Energy management [2]. This Directive was implemented into this Act via Act No. 318/2012 Coll. [3] – an amendment to Act No. 406/2000 Coll. This amendment [3] came into effect from 1st January 2013 (except for certain provisions).

According to the Energy Management Act it is necessary to demonstrate an energy performance of the building by a document which shows a considered energy performance of building. This document is called Building Energy Performance Certificate, hereinafter also referred to as "BEPC" or "certificate". This certificate is obligatory for new buildings, some kinds of existing buildings and in case of sale and lease.

Energy performance and certification

All buildings during their operations consume energy. For each building its energy requirement can be determined. This requirement is based on pre-defined boundary conditions and properties of structures and technologies occurring in the building. Based on these identified needs this building is possible to be classified and ranked within a predetermined scale.

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Energy performance

Energy performance is according to [3] calculated the amount of energy needed to meet the energy associated with the use of the building, especially for heating, cooling, ventilation, air humidity adjustment, preparation of hot water and lighting.

Energy performance is the computational requirement expressing the energy demand of the building. Actually achieved value, the consumption, may differ from the calculation. This is due to the individual needs of the user. The second possibility is that, computational assumption considered with different input data than are in the real structure (building) achieved.

Certification

The Building Energy Performance Certificate is according to [3] a document that contains specific information on the energy performance of the building or a complete part of the building. The building is understood to be a building above a ground level including its underground part that is spatially focused and externally closed mostly by external walls and roof structure. Building is at the same time such a site, in which is used some form of energy for adjusting the indoor environment. For a comprehensive part of building the law considers to be the building floor, a single apartment or other part of a building intended for separate use.

The certificate is valid for 10 years and evaluates the performance of a building from the perspective of these areas [4]:

- heating,
- cooling,
- ventilation,
- preparation of domestic hot water,
- lighting.

Cases of necessary processing of BEPC

Since the beginning of this year the Building Energy Performance Certificate is required in more cases than before. The obligation to processing the license extends from new buildings and selected types of reconstruction to all existing objects. It is important to mention that in the next period the existing buildings will constitute a majority in the licenses processed until the market is sufficiently saturated by certificated existing buildings.

New buildings

New buildings have to be designed as an energy-efficient and a part of the project documentation have to be the Building Energy Performance Certificate. The certificate is demonstrated in the building permit process. It must be prepared for all new buildings except following mentioned exceptions.

Reconstructions and changes of building

The energy performance certificate must be documented as well as in building permit process regarding the reconstruction of the building respectively its greater change. The certificate will be demonstrated, even though the change is not subject to building permit process. Greater change in the completed building is according to [3] the change more than

25 % of the total area of the building envelope. Building envelope is according to [3] the set of all heat exchange structures on the system boundary of the building or the zones that are exposed to the adjacent environment, which consists of outdoor air, the adjacent soil, indoor air in the adjacent unheated space, adjacent unheated building or adjacent zone of building heated to a lower interior designed temperature.

Existing buildings generally

Obligation to processing the certificate for existing buildings can be divided into two cases. The first case is the sale or rental of a building, or its part. The second case occurs for the act defined terms.

The certificate is necessary to have handled in the case of selling a building or comprehensive part of building, the renting the building and from 1st January 2016 also for the renting the comprehensive part of building. Comprehensive part of the building is for example an individual dwelling.

The certificate will be also needed for buildings occupied by public authorities gradually according to the size of energy reference area. From 1st July 2013 for total energy reference area larger than 500 m^2 and 1st July 2015 with a total energy reference area more than 250 m^2.

For residential houses and office buildings is the procedure very similar, but the terms are set for later. Not later than 1st January 2015 when the energy reference area is more than 1500 m^2, on 1st January 2017 when the energy reference area is more than 1000 m^2 and 1st January 2019 with energy reference area less than 1000 m^2.

Exemptions from processing of BEPC

The certificate is not necessary to process and document for buildings with a total energy reference area of less than 50 m^2, for buildings designed and commonly used as a place for worshiping and for religious purposes; for buildings used for family recreation (according to Act No. 501/2006 Coll.); in industrial and manufacturing operations, workshop premises and farm buildings with energy consumption to 700 GJ per year.

Assessment of existing buildings

When designing a new building the certificate is based on the parameters specified in the project solution. In the calculation known values are objectively appointed. The question remains how these included parameters will be complied in the construction.

However, when evaluating existing buildings we must deal with the fact that the building is already standing and evaluation should reflect this real state. This can be very difficult. The project documentation, from which it would be possible to read the input data, is not often available. Then it is possible to deduce the material solution without the use of diagnostic methods. Also the project documentation does not guarantee that it meets the reality.

From the thermo-technical (design) point of view it is necessary to ascertain the parameters of envelope structures, structures forming the heat transfer area of the building. They are mainly walls, floors, ceilings, roofs, and generally door and windows. An essential parameter is the heat transfer coefficient *U* of individual occurring structures.

Minimum background data for assessment

From the structural point of view is for a proper assessment necessary to read from documents (background data) particular dimensions of building and particular structures and their material solutions and characteristics. How accurately we will know these characteristics so more realistic the certificate will be achieved.

The fundamental basis for processing of the certificate should always be the project documentation. Unfortunately, it does not always exist. In this case it is necessary to make documentation at least in the scale for processing the certificate, it is always better to ensure processing of the real state of documentation (passport of the object). In the case that we have the project documentation, we should in any case check its consistency with the fact, which means in-situ inspection.

Unfortunately, whether project documentation is or is not available, we are only able to verify the dimensional characteristics (even though not always - flooring, laminated construction, etc.), but not really discern the material used and its properties. This is due to the fact that most of the materials are covered by a layer of plaster or build in a layered structure, which is not possible without non-destructively method or without incurring excessive efforts to explore.

In older buildings (especially the experience of the family houses) will often occur a situation where the project documentation is not available or if it is, it is often due to gradual adjustments (additions, extensions, etc.) does not correspond at all to the current real situation. In this case, there is nothing other than update processing. A part of this process must be the identification of the materials used in construction. In this case we can not expect a simple process.

Other background data for evaluation

The other way to find material solutions in construction of the building is further determining the period in which the building was constructed. And also historical knowledge of construction schedules, finding the time in which they were carried out on the object pronounced changes of building log records, documents of the materials used (invoices, orders etc.), the testimony of persons (owners, builders and other construction directly affected) and photos [4]. Precisely the detailed photographic documentation can be considered as one of the most reliable sources of information and we can rely on it when processing the certificate.

Although we can say that these documents are rather complementary, their use can be definitely recommended, because this is the only way how to at least confirm our assumptions about the used materials.

Numerical evaluation of transmission heat loss coefficient

The main input data characterizing the construction from the thermo technical point of view which enters into the calculation of the certificate is transmission heat loss coefficient *U*. Its determination is based on knowledge of the parameters of individual materials in the structure, i.e. the knowledge of their dimensions and thermal conductivity values. [4]

The importance of correct identification of the materials in the structure illustrate following calculations (tab. 1 – 2, fig. 1 – 2).

Tab. 1: Wall materials - comparison of transmission heat loss coefficient, *U*-value

Structural product	Thickness *d* [m]	Design value of thermal conductivity coefficient λ_u [W·m^{-1}·K^{-1}]	*U*-value [W·m^{-2}·K^{-1}]	Percentage comparison
Burnt full brick CPP	0,3	0,86	1,93	100 %
Perforated brick CD-TÝN	0,3	0,53	1,36	70 %
Perforated brick CD-IVA-A	0,3	0,35	0,97	50 %
Profilated brick block, type THERM P+D	0,3	0,25	0,73	38 %
Gas silicate block (about 1970)	0,3	0,30	0,85	44 %
Cinder full block	0,3	0,74	1,74	90 %
Cross perforated cinder block (NLM)	0,3	0,56	1,42	74 %
Gas silicate block (current average)	0,3	0,20	0,60	31 %
Material properties (λ_u) were used from the TEPLO 2011 software database. Calculations with horizontally heat flow rate.				

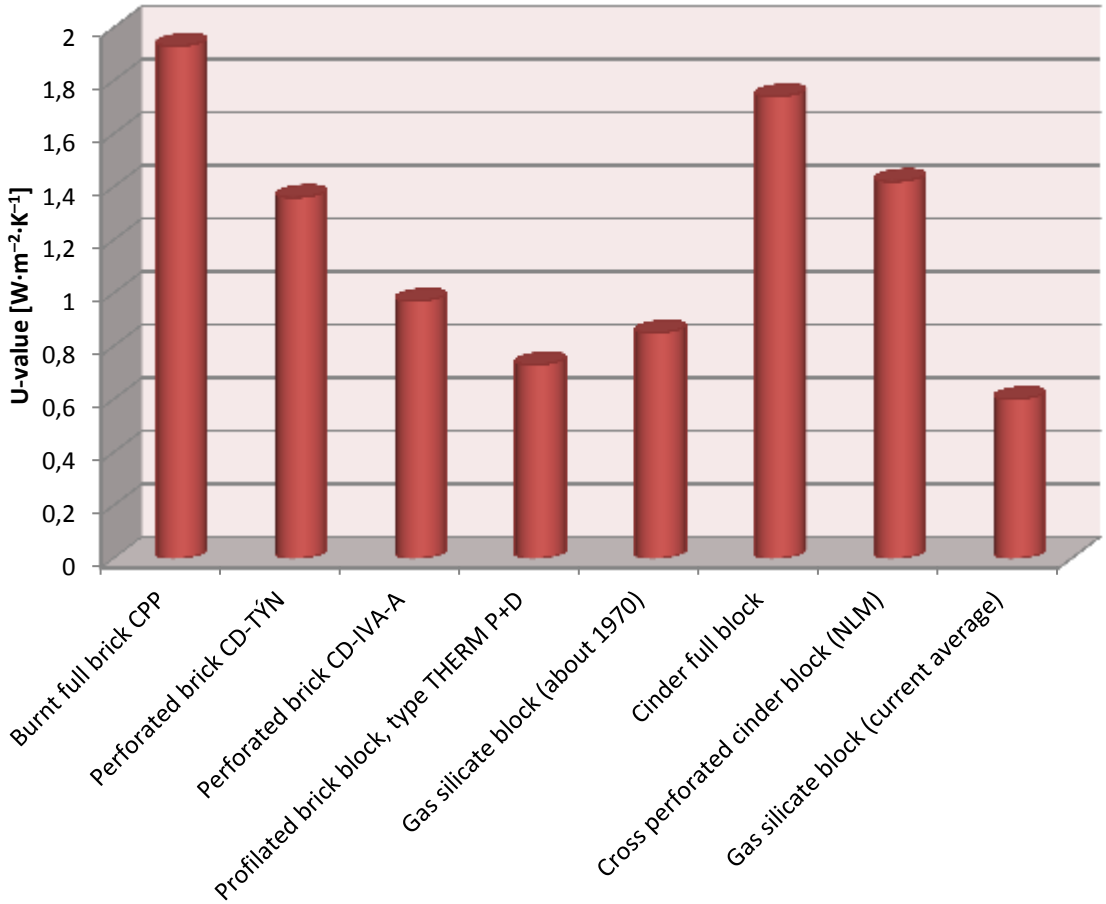

Fig. 1: Wall materials – chart of *U*-value comparison

Tab. 2: Roof truss - comparison of transmission heat loss coefficient, *U*-value

Roof truss	**Insulation thickness *d* [m]**	**Design value of thermal conductivity coefficient λ_u [W·m^{-1} ·.K^{-1}]**	***U*-value [W·m^{-2} ·K^{-1}]**	**Percentage comparison**
Roof truss with influence of rafter	0,16	0,054	0,38	100 %
Roof truss without influence of rafter	0,16	0,054	0,30	79 %
Roof truss composition: - rafter 120/160 mm, center distance 900 mm - thermal mineral insulation (older type), 160 mm, within the rafter - closed air gap, 30 mm - drywall (plasterboard), 12,5 mm				
Material properties (λ_u) were used from the TEPLO 2011 software database. *Calculations with vertically heat flow rate from the bottom up.* *Note: the correct calculation in real construction must be done with the influence of rafter!*				

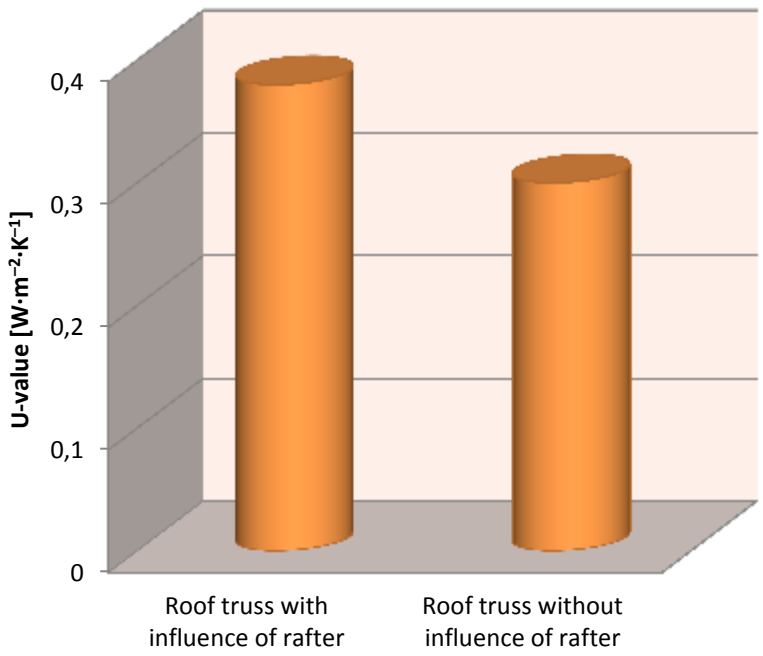

Fig. 2: Roof truss – chart of *U*-value comparison

These charts show the importance of correct input parameters determination. In case the walls are covered plaster there is complicated to verify materials unity in all area (fig. 3 demonstrates problematic building without plaster).

Fig. 3: Unsuitable combination of perimeter wall materials (Hlavsa P., 2012)

Assessment process of existing buildings

The above follows that the objectivity and the information value of certificate are strongly influenced by the correct choice of input data. Obtaining of relevant information is often very complex and assessment process of existing structures is not simple. In this process, it is necessary to carry out an extensive research operation in some cases, which often need to be supplemented by at least basic diagnostic methods.

For practice purposes it is further stated flowchart of possible steps in the processing of certificate for existing buildings (fig. 4, 5). This chart reflects the most common critical nodes and procedure according to it, should lead to formation the certificate, which the most correspond to reality, i.e. to ensure the credible information value.

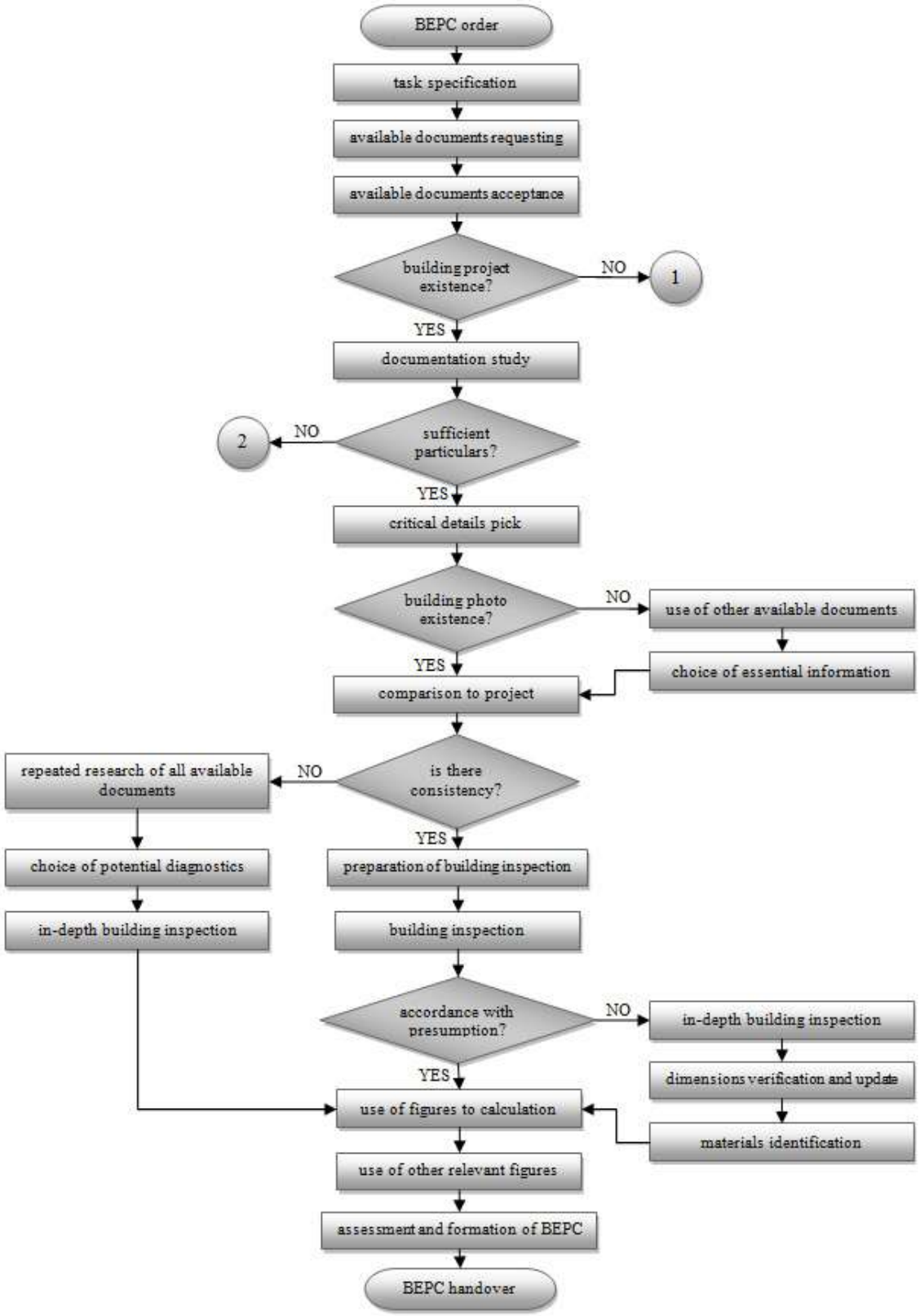

Fig. 4: Flowchart of BEPC processing – part one (Hlavsa P., 2013)

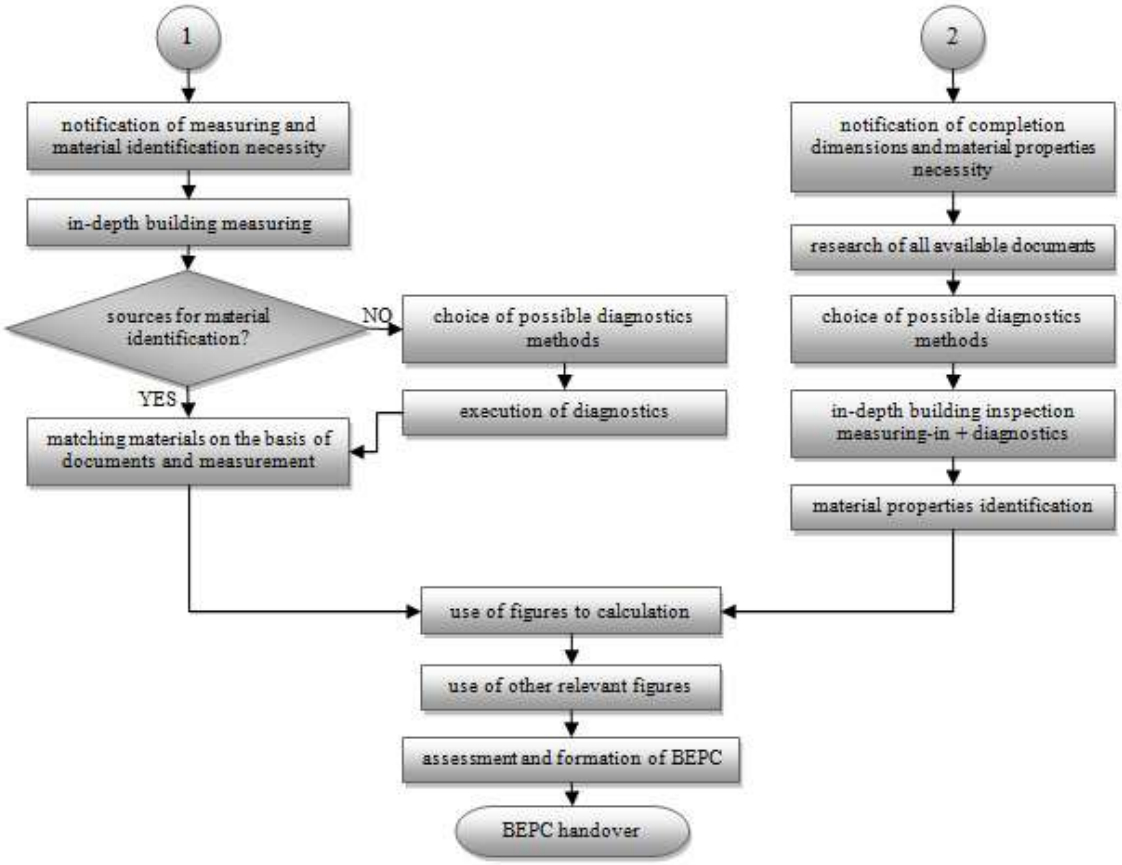

Fig. 5: Flowchart of BEPC processing – part two (Hlavsa P., 2013)

In this flowchart the sense of some used terms is:

Available documents are all documents which can be successfully used for correct assessment. The most important documents are the building project documentation and photos from the building process. Other relevant documents are building log records, material invoices or testimony of persons etc.

Critical details are those details in the building project in which could be complicated to verify stated data to the reality in building or structures.

Building inspection is an activity to verify our assumption, material solutions and dimensions of the building. In-depth building inspection is very thorough activity with detailed measuring, material identification; a special diagnostics method is often used.

Diagnostics methods are methods used for determination of material properties or detection of structure compositions. There are used only non-destructive methods, e.g. infrared thermography or technical endoscopy. Destructive methods are not desirable, but can be used in case of order.

Other relevant figures, which are used to assessment and formation of BEPC, are figures independent of structural properties and dimensions of building. There are figures and information about technical equipment – heating, cooling, lighting, preparation of domestic hot water and other relevant data required by a law.

Conclusion

The Building Energy Performance Certificate is basically a good tool for monitoring the energy efficiency of buildings. Its preparation for the new buildings is desirable. The

newly introduced evaluation even for existing buildings is on the contrary questionable. By itself, the certification of existing buildings is a good idea. But the process contains of many difficulties that for many objects we do not achieve reality corresponding certificate even in case of exerting great endeavor.

The certificate introduction for sale and lease may have an impact on the real estate market. Energy-efficient buildings will be likely more desired. However, if the certificate does not correspond to reality, it will be a building either favored or disadvantaged vice versa. This in turn may lead to a certain distortion of the real estate market.

In contrast to new buildings is in existing buildings a much greater risk that the certificate will not reflect reality, and it will not be the intention of the evaluator or the client. The intention of not quite reality corresponding certificate may as well come to the forefront, which, however, is then difficult to prove a willful act in relation to the difficulties mentioned in this paper.

It is possible to say that using a variety of sophisticated diagnostics methods, it can handle fairly credible certificate even for material complicated objects with unpreserved project documentation and other items. Unfortunately, it carries a higher time spent on processing including of course a higher financial burden on the client side. However, the legislation does not compel directly subjugating object to diagnostics, certificates will be probably usually processed only on the basis of documents, submitted by the client to evaluator, which may be significantly imperfect or misleading. The final certificate will therefore not correspond to the reality and stands up only to fulfill legal obligations, but does not become a means of expression of the basic idea. This is due to mainly financial aspect. Unluckily, on the market will occur, especially in times of total industry and economy recession, still such entities that will process the certificate on the basis of imperfect materials when the client provably declares that everything corresponds with reality.

In terms of knowledge are given in the paper the main difficulties affecting the feasibility of certificate processing from building structural point of view. It cannot forget that into the certificate enter parameters in the building occurring installations and technologies.

For technical practice purposes and awareness of the general public about the complexity of the certificate processing for existing objects this paper showed basic possible flowchart of a procedure in this challenging process. Since the evaluation of existing buildings is in the Czech Republic in its inception, this diagram can be regarded as a utility for the certificate evaluator. Following this scheme should help to ensure obtaining of enough valid certificate.

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